

Higher National Unit Specification

General information for centres

Unit title: Audio Electronics 2

Unit code: DR30 35

Unit purpose: The purpose of this Unit is to broaden candidates' awareness of the electronic concepts that impact on the operation and performance of audio equipment. The Unit will consider both analogue and digital electronics. It is a combination of conceptual knowledge and practical skills. Candidates will be encouraged to relate the conceptual content to practical situations so that they can gain an understanding of the key issues that affect equipment performance and ultimately the quality of audio reproduction and processing.

On completion of the Unit the candidate should be able to:

- 1 Assess the performance of a typical microphone.
- 2 Assess the performance of analogue subsystems.
- 3 Design switching and routing arrangements for audio signal paths.
- 4 Create algorithms for digital audio processes.
- 5 Evaluate the performance of a typical digital audio device.

Credit points and level: 2 HN Credits at SCQF level 8: (16 SCQF credit points at SCQF level 8*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit is at the discretion of the centre. However, it would be beneficial if candidates had completed the HN Unit: Audio Electronics 1 (DJ1X 34).

Core Skills: There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Assessment: The Unit contains a combination of conceptual knowledge and practical skills. Accordingly, assessments will measure candidates' performance in each of these areas. It is intended, however, that this Unit be used to bridge the gap between theory and practice.

General information for centres (cont)

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Outcomes 1 and 2 should be assessed by an experimental/research project. As well as carrying out performance tests, candidates will be expected to devise the tests and select appropriate test equipment. Candidates may use measurements taken by them, combined with taught conceptual information, to determine possible and/or suitable applications.

Outcome 3 features design aspects that primarily relate to the operation of mixing consoles. As such, it is recommended that the assessment be carried out with reference to the audio routing of mixing consoles.

Outcome 4 deals with the use of Digital Signal Processing (DSP) integrated circuits, and the assessment should consider the theoretical aspects of digital signal processing together with the specific requirements of a DSP device. The assessment will be carried out in supervised, open-book conditions and should last no longer than one hour.

For Outcome 5, candidates should select a particular digital audio device and use this as a case study on which to base a submitted report. Where the device does not feature all the areas listed in the Evidence Requirements section, there must be additional information allowing candidates to demonstrate satisfactory achievement.

Higher National Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Assess the performance of a typical microphone

Knowledge and/or skills

- ◆ The relevance of frequency response, polar response, transient response and sensitivity to selection for practical applications.
- ◆ Testing the frequency response characteristics of a microphone.
- ◆ Testing the polar response of a microphone.
- ◆ Use of test equipment to obtain the frequency response characteristics and polar response of a microphone.
- ◆ Limitations of test conditions.
- ◆ Presentation of technical information in an appropriate format.

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can obtain, with the proper use of appropriate test equipment and through a properly designed test strategy, the frequency response characteristics and polar response of an unmarked microphone.

Candidates will be expected to show awareness of the implications of the tests being used, eg the influence of the frequency of test signals on obtained polar response, and describe clearly the limitations of the tests being performed. They will be expected to present the findings of the test in an appropriate format, and relate the main performance characteristics of microphones to practical applications.

Assessment guidelines

This assessment features test design, testing and reporting test findings. The various aspects of the assessment should be grouped to form a single exercise, with candidates being given sufficient time, resources and environments to complete the necessary work.

Should there be ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 2

Outcome 2

Assess the performance of analogue subsystems

Knowledge and/or skills

- ◆ The relevance of frequency response and dynamic range of analogue subsystems to selection for practical applications
- ◆ Design features which influence frequency response and dynamic range of analogue subsystems
- ◆ Testing the frequency response and dynamic range of line pre-amplifiers and fixed response filters
- ◆ The use of test equipment to obtain the frequency response and dynamic range of line pre-amplifiers and fixed response filters
- ◆ Presentation of technical information in an appropriate manner

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can obtain, with the use of appropriate test equipment and through a properly designed test strategy, the frequency response and dynamic range of line pre-amplifiers and a fixed response filter. They will need to demonstrate that they can present technical information in an appropriate format, and this will include:

- ◆ description of test strategy and equipment used
- ◆ overview of the results of tests carried out
- ◆ the relationship between frequency response and dynamic range and suitable, practical applications

Assessment guidelines

This assessment features test design, testing and reporting test findings. The various aspects of the assessment should be grouped to form a single exercise, with candidates being given sufficient time, resources and environments to complete the necessary work.

The circuits which candidates use should be pre-built. Alternatively, the exercise can be carried out using circuit simulation software.

Should there be ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 2

Outcome 3

Design switching and routing arrangements for audio signal paths

Knowledge and/or skills

- ◆ Poles, throws and ways in switching arrangements
- ◆ Latching and non-latching switches
- ◆ Mechanical linkages in multi-pole switches
- ◆ Switched connectors
- ◆ Stacked potentiometers for pan controls
- ◆ Appropriate symbols and drawing conventions to British standards

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can produce designs for the switching arrangement for:

- ◆ mono and stereo input selection from at least three possible input sources
- ◆ by-pass switching
- ◆ electrical mains switching
- ◆ insert point switching using switched connectors
- ◆ routing to auxiliary busses
- ◆ routing to record sends via the pan potentiometers

In providing the evidence required candidates will be expected to:

- ◆ use correct symbols from British standards
- ◆ show proper graphical representation of electrical connections
- ◆ show proper graphical representation of mechanical linkages
- ◆ complete diagrams neatly

Assessment guidelines

This assessment is a design exercise requiring the presentation of a number of different designs for switching arrangements for audio signal paths. A single, practical device can be used as reference, eg the switching required for the various functions of an audio mixing console.

Should there be ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 2

Outcome 4

Create algorithms for digital audio processes

Knowledge and/or skills

- ◆ Methodology for signal level adjustment in the digital domain
- ◆ Methodology for signal summation in the digital domain
- ◆ Methodology for signal time delay adjustment in the digital domain
- ◆ The need for fast Fourier analysis of audio inputs
- ◆ Architecture of Digital Signal Processing (DSP) integrated circuits
- ◆ Representation of signal processing using appropriate algorithmic constructs

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can, for a particular Digital Signal Processing (DSP) integrated circuit, provide:

- ◆ an algorithm for a digital gain controller
- ◆ an algorithm for a digital audio buss input
- ◆ an algorithm for an equalisation controller
- ◆ an algorithm for a reverb processor

It is recommended that this assessment be carried out in controlled, open-book conditions to allow candidates to relate theory to practice. The assessment should be carried out within a one hour working period.

Assessment guidelines

Should there be ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Outcome 5

Evaluate the performance of a typical digital audio device

Knowledge and/or skills

- ◆ The performance of analogue to digital converter
- ◆ Oversampling and noise shaping
- ◆ Channel coding
- ◆ Compression techniques
- ◆ Single bit digital to analogue conversion
- ◆ The trade off between capacity, access speed and power consumption of storage devices

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 2

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that, for a digital audio device, they can:

- ◆ relate the specification of an analogue to digital converter to resulting audio performance
- ◆ describe the improvement in audio performance by the inclusion of oversampling and noise shaping
- ◆ describe the need for channel coding, and the operation of encoding prior to storage and decoding after retrieval
- ◆ discuss the advantages and disadvantages of applying digital compression techniques
- ◆ discuss the issues relating to single bit digital to analogue conversion
- ◆ discuss capacity, access speed and power consumption in relation to storage devices

Assessment guidelines

Candidates should select a particular digital audio device for this exercise and submit a report which satisfies the listed Evidence Requirements.

In situations where candidates choose an actual device which may not feature all areas in the Evidence Requirements, there will need to be inclusion of supplementary information to satisfy all the requirements.

Should there be ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Administrative Information

Unit code:	DR30 35
Unit title:	Audio Electronics 2
Superclass category:	XL
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Higher National Unit specification: support notes

Unit title: Audio Electronics 2

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this Unit

This Unit is primarily intended to give candidates a vehicle for relating conceptual knowledge to their implication in practical situations. By providing opportunities for both experimentation and design, candidates will be able to see how specification relates to performance and, hence, practical applications. Candidates should have completed the HN Unit Audio Electronics 1 (DJ1X 34) prior to undertaking this Unit.

In Outcome 1 the basic performance figures for microphones are considered and candidates are then expected to be able to measure figures for actual microphones. Candidates will have to consider what is to be measured and determine appropriate test environments and equipment to make the required measurements. Candidates will then be expected to document measurements and, from these measurements, draw appropriate conclusions for practical applications.

In Outcome 2 the approach described above for Outcome 1 should be used for both pre-amplifiers and filters.

In Outcome 3 switching and routing arrangements used in mixing consoles are considered. Such arrangements are normally depicted in schematics provided in manufacturers' literature. This Outcome will equip candidates with the ability to interpret these schematics and so infer connection and routing procedures through a developed topological view of a mixing console.

Outcome 4 gives candidates an opportunity to determine how signal processing is carried out in the digital domain. It is likely that the necessary sub-processes for typical audio processing be dealt with in the analogue domain, providing a secure platform for candidates to appreciate the requirements in the digital domain.

In Outcome 5 there is further opportunity to link conceptual information to practical applications. Candidates are asked to consider the specification of actual digital audio devices and see how these relate to the audio performance figures like dynamic range, frequency response, harmonic distortion and so on.

Guidance on the delivery and assessment of this Unit

This has been developed as an optional Unit within the Group Award framework for HND Sound Production, but can also be taken on a stand-alone basis.

For Outcome 1 it will be necessary to firmly establish the significance of the key performance figures of microphones, ie polar response, frequency response, transient response and sensitivity. Candidates will need to be introduced to the role and operation of test devices like signal generators and oscilloscopes. Candidates will need to develop an awareness of the environmental considerations for audio performance testing.

Higher National Unit specification: support notes (cont)

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The delivery of Outcome 2 should be carried out on circuits which are pre-built and facilitate easy testing. Alternatively, a virtual approach can be used via electronic circuit simulation software.

Outcome 3 should focus on specific models of mixing consoles, with reference to schematics provided in manufacturers' literature. Practical operations should be related to the signal paths derived from these schematics.

In Outcome 4 candidates should be introduced to a particular Digital Signal Processing (DSP) device in terms of its architecture and algorithm constructs.

In Outcome 5, the digital performance specifications considered should always relate to the specification of actual digital audio devices which would be seen in common audio situations.

Open learning

It may be possible for this Unit to be completed on an open learning basis, although centres will need to devise and approve methods for ensuring the validity of submitted work that contributes to assessment evidence.

For further information and advice please refer to *Assessment and Quality Assurance for Open and Distance Learning (SQA, — publication code A1030)*.

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website www.sqa.org.uk.

General information for candidates

Unit title: Audio Electronics 2

In this Unit, the concepts from the HN Unit Audio Electronics 1 (DJ1X 34) will be developed.

In Outcome 1 you will gain a wider appreciation of the important performance figures for microphones and how these determine possible, suitable applications. As well as understanding what these figures are, you will be introduced to methods for determining specifications by carrying out pre-determined tests.

Outcome 2 will introduce you to the performance of aspects of audio pre-amplifiers and filters, typically found in mixing consoles and analogue audio signal processors like compressors and equalisers. Again the link between the audio performance figures and their implications for actual applications will be considered. Practical tests will be carried out to measure performance figures for subsystems.

The content of Outcome 3 will allow you to develop a topological understanding of mixing desks and this will, in turn, allow you to infer the connection and routing operations necessary in specific situations. Developing your ability to interpret the information presented in manufacturers' publications will enable you to do this.

In Outcome 4 you will be introduced to the role and operation of digital signal processors. The architecture of these will be covered along with how algorithms can be created to provide audio processes like gain, signal summations and time domain control.

Finally, in Outcome 5, you will have the opportunity to gain an understanding of how and why digital specification values, like sample rate and word size, have an influence on audio performance figures like frequency response, dynamic range and harmonic distortion. You will look at the specifications of actual digital audio devices and determine the audio performance — this will allow you to accurately assess suitability for practical applications.

The Unit contains a combination of conceptual knowledge and practical skills. Accordingly, assessments will measure your performance in each of these areas. This Unit should bridge the gap between theory and practice.

Outcomes 1 and 2 should be assessed by an experimental/research project. As well as carrying out performance tests, you will be expected to devise the tests and select appropriate test equipment.

Outcome 3 features design aspects that primarily relate to the operation of mixing consoles, the assessment will therefore be carried out with reference to the audio routing of mixing consoles.

Outcome 4 deals with the use of Digital Signal Processing (DSP) integrated circuits, the assessment considers the theoretical aspects of digital signal processing together with the specific requirements of a DSP device.

For Outcome 5, you should select a particular digital audio device and use this as a case study on which to base a submitted report.